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(54) OFDM COMMUNICATION EQUIPMENT

(57)Abstract:

PROBLEM TO BE SOLVED: To guarantee communication efficiency and communication quality even when maximum delay time is changed by the installation place or use time band of orthogonal frequency division multiplex(OFDM) communication equipment.

SOLUTION: A measuring symbol transmitting part 22 successively transmits series of measuring symbols. A measuring symbol receiving part 23 successively receives the measuring symbols transmitted through a communication channel 21 and detects a shortest guard interval length κ, which can be confirmed. A notice transmitting part 25 reports κ to a notice receiving part 26. The notice receiving part 26 outputs the reported κ to a data symbol transmitting part 30. While using the guard interval length κ, the data symbol transmitting part 30 generates a data symbol ω of OFDM from inputted transmission data X and transmits it. While using the guard interval length κ, a data symbol receiving part 31 is receives the transmitted data symbol ω of OFDM and outputs received data Y.
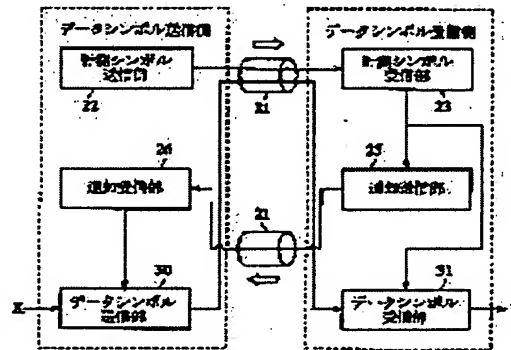
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* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] More specifically, this invention relates to adaptation-control of the guard interval in an OFDM communication device about an orthogonal frequency division multiplex (OFDM is called below Orthogonal FrequencyDivision Multiplexing:) communication device.
[0002]
[Description of the Prior Art] Generally, an OFDM signal is constituted by an effective symbol period and the guard interval. An effective symbol period is a symbol period including the signal for transmitting data. A guard interval is a period inserted in order to make the influence of a multi-pass mitigate. For example, a guard interval includes redundant signals, such as a signal with which the effective symbol was repeated. By inserting this guard interval into an OFDM signal, the influence by the delay wave of guard interval length within the limits is avoidable.
[0003] In the former, the method of defining a predetermined value beforehand may be taken in consideration of the maximum time delay of the multiple rays under environment with the common guard interval length in an OFDM communication device.
[0004] Moreover, the method of not defining a predetermined value beforehand may be taken. In the former, as JP,9-135230,A shows, a certain system parameter is notified from a data symbol sending set to a data symbol receiving set, and there is a method of changing guard interval length. Furthermore, for example, as JP,10-308716,A shows, there is a method of detecting the guard interval length changed by the data symbol transmitting side by the data symbol receiving side. Each of these methods is methods corresponding to change of the guard interval length by the data symbol transmitting side in a data symbol receiving side.
[0005]
[Problem(s) to be Solved by the Invention] Generally, the propagation-delay time is sharply changed with an installation, a time band, etc. of equipment. Therefore, compared with the time delay beforehand set as the system, when the actual time delay is smaller, the guard interval more than required will be used. In such a case, communication efficiency will fall. Moreover, compared with the time delay beforehand set as the system, when the actual time delay is larger, influence of a delay wave cannot be absorbed by the guard interval. In such a case, communication quality will deteriorate.
[0006] And in the above conventional examples, since a data symbol receiving side corresponds to change of the guard interval length by the data symbol transmitting side, the changed guard interval does not necessarily suit an actual time delay.
[0007] Then, the propagation environment to change is measured, the guard interval period which suits an actual time delay is adjusted in adaptation, and the method of optimizing guard interval length is desired.
[0008] The purpose of this invention is offering the OFDM communication device for measuring the propagation environment changed in this way by the measurement symbol, and optimizing a guard interval period in adaptation.
[0009]
[A The means for solving a technical problem and an effect of the invention] [when the 1st

invention transmits an OFDM signal from a sending station to a receiving station] It is an OFDM communication device for adjusting in adaptation the guard interval contained in the OFDM symbol in the OFDM signal concerned. A measurement symbol transmitting means to transmit the measurement symbol for asking for the guard interval length corresponding to the maximum time delay of a delay wave, A measurement symbol is received and it has a measurement symbol receiving means to compute the optimal guard interval length, and a guard interval adjustment means to adjust in adaptation the guard interval contained in an OFDM symbol using the computed guard interval length.

[0010] In the 1st above-mentioned invention, the propagation environment to change is measured, the guard interval period which suits an actual time delay is adjusted in adaptation, and the optimal guard interval is used. Therefore, communication efficiency can be raised.

[0011] The 2nd invention is an OFDM communication device in the 1st invention. a measurement symbol transmitting means It is prepared in a sending-station side. a measurement symbol receiving means It is prepared in a receiving station side. a guard interval adjustment means A notice transmitting means to transmit the notice containing the guard interval length who was prepared in the receiving station side and computed by the measurement symbol receiving means to a sending-station side, A notice receiving means to be prepared in a sending-station side, to receive the notice from a notice transmitting means, and to acquire the computed guard interval length, It is prepared in a sending-station side and the guard interval length acquired by the notice receiving means is set up as a parameter. A data symbol transmitting means to transmit the data symbol which has the guard interval length concerned to a receiving station side, It is prepared in a receiving station side, the guard interval length computed by the measurement symbol receiving means is set up as a parameter, and a data symbol receiving means to receive the data symbol which has the guard interval length concerned is included.

[0012] In the 2nd above-mentioned invention, using a notice transmitting means and a notice receiving means, the guard interval period in a data symbol transmitting side and a data symbol receiving side is adjusted in adaptation, and the optimal guard interval is used. Therefore, communication efficiency can be raised. Moreover, a data symbol transmitting side can measure leading.

[0013] [when the 3rd invention is an OFDM communication device in the 2nd invention and one sending station communicates with two or more receiving stations] a guard interval adjustment means The guard interval length for two or more receiving stations of every which were prepared in the sending-station side and inputted from the notice receiving means A transmitting-side guard interval length storage means to make correspond with each receiving station and to memorize is included further. a transmitting-side guard interval length storage means When the receiving station of a communication place is chosen, it is characterized by reading the guard interval length corresponding to the selected receiving station concerned, and outputting to a data symbol transmitting means.

[0014] In the 3rd above-mentioned invention, a guard interval which is different for every communication place in a sending-station side is set up and memorized. The optimal guard interval is set up for every communication place by that, and communication efficiency can be raised by it.

[0015] [when the 4th invention is an OFDM communication device in the 2nd invention and two or more sending stations communicate with one receiving station] a guard interval adjustment means The guard interval length for two or more sending stations of every which were prepared in the receiving station side and computed by the measurement symbol receiving means A receiving-side guard interval length storage means to make correspond with each sending station and to memorize is included further. a receiving-side guard interval length storage means When the sending station of a communication place is chosen, it is characterized by reading the guard interval length corresponding to the selected sending station concerned, and outputting to a data symbol receiving means.

[0016] In the 4th above-mentioned invention, a guard interval which is different for every communication place in a receiving station side is set up and memorized. The optimal guard interval is set up for every communication place by that, and communication efficiency can be raised by it.

[0017] [when the 5th invention is an OFDM communication device in the 2nd invention and two or

more sending stations communicate with two or more receiving stations] a guard interval adjustment means A transmitting-side guard interval length storage means for it to be prepared in a sending-station side, to make the guard interval length for two or more receiving stations of every inputted from the notice receiving means correspond with each receiving station, and to memorize, The guard interval length for two or more sending stations of every which were prepared in the receiving station side and computed by the measurement symbol receiving means A receiving-side guard interval length storage means to make correspond with each sending station and to memorize is included further. a transmitting-side guard interval length storage means When the receiving station of a communication place is chosen, the guard interval length corresponding to the selected receiving station concerned is read, it outputs to a data symbol transmitting means and, as for a receiving-side guard interval length storage means, the sending station of a communication place is chosen, It is characterized by reading the guard interval length corresponding to the selected sending station concerned, and outputting to a data symbol receiving means.

[0018] In the 5th above-mentioned invention, a different guard interval for every communication place is set up and memorized in the both sides by the side of a sending station and a receiving station. The optimal guard interval is set up for every communication place by that, and communication efficiency can be raised by it.

[0019] The 6th invention is an OFDM communication device in the 1st invention. a measurement symbol transmitting means It is prepared in a receiving station side. a measurement symbol receiving means It is prepared in a sending-station side. a guard interval adjustment means A notice transmitting means to transmit the notice containing the guard interval length who was prepared in the sending-station side and computed by the measurement symbol receiving means to a receiving station side, A notice receiving means to be prepared in a receiving station side, to receive the notice from a notice transmitting means, and to acquire the computed guard interval length, It is prepared in a sending-station side and the guard interval length computed by the measurement symbol receiving means is set up as a parameter. A data symbol transmitting means to transmit the data symbol which has the guard interval length concerned to a receiving station side, It is prepared in a receiving station side, the guard interval length acquired by the notice receiving means is set up as a parameter, and a data symbol receiving means to receive the data symbol which has the guard interval length concerned is included.

[0020] In the 6th above-mentioned invention, using a notice transmitting means and a notice receiving means, the guard interval period in a data symbol transmitting side and a data symbol receiving side is adjusted in adaptation, and the optimal guard interval is used. Therefore, communication efficiency can be raised. Moreover, a data symbol receiving side can measure leading.

[0021] [when the 7th invention is an OFDM communication device in the 6th invention and one sending station communicates with two or more receiving stations] a guard interval adjustment means The guard interval length for two or more receiving stations of every which were prepared in the sending-station side and computed by the measurement symbol receiving means A transmitting-side guard interval length storage means to make correspond with each receiving station and to memorize is included further. a transmitting-side guard interval length storage means When the receiving station of a communication place is chosen, it is characterized by reading the guard interval length corresponding to the selected receiving station concerned, and outputting to a data symbol transmitting means.

[0022] In the 7th above-mentioned invention, a guard interval which is different for every communication place in a sending-station side is set up and memorized. The optimal guard interval is set up for every communication place by that, and communication efficiency can be raised by it.

[0023] [when invention of the octavus is an OFDM communication device in the 6th invention and two or more sending stations communicate with one receiving station] a guard interval adjustment means The guard interval length for two or more sending stations of every which were prepared in the receiving station side and inputted from the notice receiving means A receiving-side guard interval length storage means to make correspond with each sending station and to memorize is included further. a receiving-side guard interval length storage means When the sending station of a communication place is chosen, it is characterized by reading the guard interval length

corresponding to the selected sending station concerned, and outputting to a data symbol receiving means.

[0024] In invention of the above-mentioned octavus, a guard interval which is different for every communication place in a receiving station side is set up and memorized. The optimal guard interval is set up for every communication place by that, and communication efficiency can be raised by it.

[0025] [when the 9th invention is an OFDM communication device in the 6th invention and two or more sending stations communicate with two or more receiving stations] a guard interval adjustment means A transmitting-side guard interval length storage means for it to be prepared in a sending-station side, to make the guard interval length for two or more receiving stations of every computed by the measurement symbol receiving means correspond with each receiving station, and to memorize, The guard interval length for two or more sending stations of every which were prepared in the receiving station side and inputted from the notice receiving means A receiving-side guard interval length storage means to make correspond with each sending station and to memorize is included further. a transmitting-side guard interval length storage means When the receiving station of a communication place is chosen, the guard interval length corresponding to the selected receiving station concerned is read, it outputs to a data symbol transmitting means and, as for a receiving-side guard interval length storage means, the sending station of a communication place is chosen, It is characterized by reading the guard interval length corresponding to the selected sending station concerned, and outputting to a data symbol receiving means.

[0026] In the 9th above-mentioned invention, a different guard interval for every communication place is set up and memorized in the both sides by the side of a sending station and a receiving station. The optimal guard interval is set up for every communication place by that, and communication efficiency can be raised by it.

[0027] The 10th invention is an OFDM communication device in the 1st invention, and a measurement symbol transmitting means is characterized by transmitting two or more measurement symbols. In the 10th above-mentioned invention, the guard interval length who has the optimal time length can be chosen by using two or more measurement symbols.

[0028] The 11th invention is an OFDM communication device in the 10th invention, and two or more measurement symbols contain the effective symbol as which each contained access-control data. According to the 11th above-mentioned invention, an access demand etc. can be controlled simultaneously with transmission of a measurement symbol, and a band can be used efficiently. Moreover, since the newest time delay is measured for every access, adaptability increases.

[0029] The 12th invention is an OFDM communication device in the 10th invention, and two or more measurement symbols contain the guard interval which has time [when each differs] length. In the 10th above-mentioned invention, it can ask for the optimal guard interval length by using the guard interval which has the time [to differ] length contained in two or more measurement symbols.

[0030] The 13th invention is an OFDM communication device in the 12th invention, and a measurement symbol receiving means is characterized by computing the shortest guard interval length in the measurement symbol which can be recognized among two or more measurement symbols which the measurement symbol transmitting means transmitted as optimal guard interval length.

[0031] What is necessary is just to receive the measurement symbol which has the guard interval of different length, and to choose the optimal guard interval length among the guard intervals contained in them in the 13th above-mentioned invention. Therefore, acquisition of the maximum time delay can carry out easily and can constitute equipment simply.

[0032] The 14th invention is an OFDM communication device in the 1st invention, and a measurement symbol transmitting means is characterized by transmitting one measurement symbol containing a predetermined guard interval and a predetermined effective symbol.

[0033] In the 14th above-mentioned invention, a guard interval period can be easily adjusted in adaptation by using the measurement symbol of simple composition. Therefore, communication efficiency can be raised.

[0034] The 15th invention is an OFDM communication device in the 14th invention, and the data with which the predetermined guard interval was contained to one half in the second half of an

effective symbol, and an amplitude contain the null data of 0.

[0035] In the 15th above-mentioned invention, null data are added to the second half data of an effective symbol, and a long guard interval is generated. By this, an unnecessary correlation peak is not generated and the maximum time delay can be found easily.

[0036] The 16th invention is an OFDM communication device in the 14th invention, and a measurement symbol receiving means is characterized by for a correlation operation detecting the delay wave which has influence of [more than predetermined] on the quality of an input signal among the delay waves contained in the received signal, and computing the optimal guard interval length from the maximum time delay of the detected delay wave.

[0037] In the 16th above-mentioned invention, the time delay of a delay wave is detected from the correlation peak by the correlation operation. Therefore, from the maximum time delay, a guard interval period can be easily adjusted in adaptation, and communication efficiency can be raised.

[0038] The 17th invention is an OFDM communication device in the 16th invention. a measurement symbol receiving means A symbol synchronous means to ask for the head of a symbol from the received signal, and to output the timing, The 1st buffer means which timing is inputted and outputs data constellation beta equal to the length of an effective symbol from the head of a measurement symbol, The 2nd buffer means which takes out serially data constellation alpha which has the length of an effective symbol while making it slip in the direction of a time-axis within the period equivalent to the length of the guard interval contained in the symbol concerned from the head of a measurement symbol, The inside of the time which a correlation operation means to calculate the correlation value of data constellations alpha and beta, and the 2nd buffer means made the head of a measurement symbol slip as an origin, It has a time delay detection means to detect time for a correlation value to exceed predetermined threshold gamma one by one as a time delay of a delay wave, and to compute the greatest time delay as optimal guard interval length among the time delays of the detected delay wave.

[0039] A correlation value fills threshold gamma with the 17th above-mentioned invention, and makes time to be equivalent to the largest slide position the maximum time delay by it. Therefore, a correlation peak is acquired in the slide position where a delay wave exists, and the maximum time delay can be correctly detected by specifying by threshold gamma.

[0040] The 18th invention is an OFDM communication device in the 17th invention, and a time delay detection means is characterized by computing threshold gamma by carrying out the multiplication of the predetermined coefficient delta for normalizing to the time-average value of a correlation value.

[0041] In the 18th above-mentioned invention, since it changes by the distribution of a correlation value, optimal threshold gamma is normalized using a time-average value. By this, the maximum time delay can be found correctly.

[0042]

[Embodiments of the Invention] When the OFDM communication device concerning these operation forms is constituted, three differences used as the feature are put together, and the 1st of this invention explained below or the 8th operation form is constituted so that each may differ. The 1st constitutional difference is a point whether the measurement symbol transmitting section (or measurement symbol receive section) is in a data symbol receiving side, or to be in a transmitting side. The 2nd difference is a point whether it has the guard interval length storage section or it has. The 3rd difference is a point whether whether the measurement symbol transmitting section 22 and the measurement symbol receive section 23 are used, the measurement symbol transmitting section 32, and the measurement symbol receive section 33 are used for the measurement symbol transmitting section and a measurement symbol receive section. Bearing the combination of the above difference in mind, each operation form concerning this invention is explained in order hereafter.

[0043] (1st operation gestalt) Drawing 1 is the block diagram having shown the composition of the OFDM communication device concerning the 1st operation gestalt of this invention. The measurement symbol transmitting section 22 to which the OFDM communication device concerned transmits a predetermined measurement symbol in drawing 1 , Receive the measurement symbol concerned, and while setting guard interval length as kappa with the measurement symbol receive

section 23 which outputs the shortest guard interval length kappa that has recognized The data symbol receive section 31 which receives the data symbol omega of OFDM and outputs received-data Y, While setting guard interval length as kappa with the notice transmitting section 25 which notifies the guard interval length kappa, and the notice receive section 26 which receives a notice and outputs the notified guard interval length kappa to the data symbol transmitting section 30 Transmit data X is inputted and it has the data symbol transmitting section 30 which transmits the data symbol omega of OFDM.

[0044] Moreover, above-mentioned each part is prepared in a data symbol transmitting side and a data symbol receiving side, respectively. The measurement symbol transmitting section 22, the notice receive section 26, and the data symbol transmitting section 30 are formed in a data symbol transmitting side. The measurement symbol receive section 23, the notice transmitting section 25, and the data symbol receive section 31 are formed in a data symbol receiving side. Thus, as for the OFDM communication device concerning the 1st operation gestalt of this invention, it is the feature that the measurement symbol transmitting section 22 is formed in a data symbol transmitting side.

[0045] In drawing 1 , the measurement symbol transmitting section 22 transmits two or more measurement symbols containing the guard interval which has predetermined length. Drawing 2 is a ** type view showing the composition of two or more measurement symbols transmitted. As shown in drawing 2 , the measurement symbol concerned is constituted by the guard interval which has predetermined length, and the effective symbol.

[0046] In drawing 2 , four measurement symbols are shown and the length of a guard interval has the predetermined length from which each differs. The guard interval length whom the measurement symbol transmitted first has typically is set up comparatively long, and what is transmitted behind is set up comparatively short. Of course, the number of measurement symbols transmitted is not restricted to four.

[0047] Drawing 3 is the ** type view having shown the composition of a measurement symbol. In drawing 3 , a measurement symbol consists of a guard interval and an effective symbol. A guard interval has the time length of kappa. Typically, an effective symbol has predetermined access-control data including the access demand.

[0048] Moreover, access-control data contain the identifier of a communicating agency and a communication place. A peculiar sign or a peculiar value is beforehand assigned to the identifier to each so that the transmitting side and receiving side of access-control data can be discriminated from an other station.

[0049] Of course, be [what is necessary / just since the measurement symbol receive section 23 can be recognized], the content of an effective symbol does not necessarily need to have access-control data, and is not limited especially.

[0050] However, if the effective symbol has access-control data, it can control an access demand etc. simultaneously with transmission of a measurement symbol. In this case, since a band can be used efficiently, it is desirable. Therefore, an effective symbol is explained below as what has predetermined access-control data.

[0051] First, the measurement symbol transmitting section 22 will transmit a series of above measurement symbols one by one, if transmit data X occurs. About the timing of the transmission, if the number of communication places is one, whenever transmit data X will occur, it is not necessary to transmit a measurement symbol.

[0052] However, it is desirable that a measurement symbol is transmitted whenever transmit data X occurs since the optimal guard interval length differs for every communication place when there are two or more communication places. Below, it explains on the assumption that a measurement symbol is transmitted, whenever transmit data X occurs.

[0053] Next, the measurement symbol receive section 23 receives a series of measurement symbols transmitted through a communication channel 21 one by one, and recognizes the access-control data in an effective symbol. In a detail, the measurement symbol receive section 23 recognizes more that the identifier of a transmission place is the thing of ****** among the identifiers contained in access-control data.

[0054] What is first transmitted like drawing 2 shall be comparatively long, the guard interval length whom this measurement symbol has shall be set up, and what is transmitted behind shall be set up

comparatively short.

[0055] When set up, the measurement symbol receive section 23 may be able to stop thus, being able to recognize the access-control data transmitted behind under the influence of multiple rays, as a result of a guard interval's being too short. At this time, the measurement symbol receive section 23 can obtain the shortest guard interval length kappa that the symbol of the last which has recognized access-control data has. It is the same when all access-control data have been recognized.

[0056] When two or more measurement symbols [like drawing 2] whose drawing 4 is are transmitted, it is the ** type view showing how the measurement symbol receive section 23 obtains the shortest guard interval length kappa. As shown in drawing 4 , the guard interval length kappa is guard interval length of the last symbol who has recognized access-control data.

[0057] Thus, the measurement symbol receive section 23 detects the shortest guard interval length kappa that has recognized access-control data, and outputs kappa to the notice transmitting section 25 and the data symbol receive section 31.

[0058] Next, the notice transmitting section 25 notifies the guard interval length kappa inputted from the measurement symbol receive section 23 to the notice receive section 26 in which it was prepared by the data symbol transmitting side. The identifier of a transmitting agency and a transmission place is contained in this notice. As mentioned above, a transmitting side and a receiving side are discriminable from an other station with an identifier.

[0059] The notice receive section 26 receives the notice transmitted through a communication channel 21, and outputs the guard interval length kappa contained in the notice concerned to the data symbol transmitting section 30.

[0060] The data symbol transmitting section 30 sets the guard interval length of a data symbol transmitting side as kappa. Then, the data symbol transmitting section 30 generates the data symbol omega of transmit data X to inputted OFDM using the set-up guard interval length kappa, and transmits to the data symbol receive section 31.

[0061] The data symbol receive section 31 sets up kappa inputted from the measurement symbol receive section 23 as guard interval length of a data symbol receiving side. Then, the data symbol receive section 31 receives the data symbol omega of OFDM transmitted through a communication channel 21 using the set-up guard interval length kappa, and outputs received-data Y.

[0062] As explained above, the OFDM communication device of the 1st example concerning this invention uses the optimal guard interval based on the time delay in adaptation by using a measurement symbol. Therefore, communication efficiency can be raised. Moreover, since an access demand etc. is simultaneously [with transmission of a measurement symbol] controllable, a band can be used efficiently.

[0063] (2nd operation gestalt) Drawing 5 is the block diagram having shown the composition of the OFDM communication device concerning the 2nd operation gestalt of this invention. The measurement symbol transmitting section 22 which transmits the predetermined measurement symbol in which the OFDM communication device concerned contained the identifier rho of a communicating agency, and the identifier psi of a communication place in drawing 5 , The measurement symbol receive section 23 which receives the measurement symbol concerned and outputs the shortest guard interval length kappa that has recognized, and Identifier rho, The guard interval length storage section 28 which outputs the guard interval length kappa who corresponds if the guard interval length kappa and Identifier rho which were inputted are made a set, and are memorized and the identifier rho of a communication place is inputted, The data symbol receive section 31 which receives the data symbol omega of OFDM and outputs received-data Y while setting guard interval length as kappa, The notice transmitting section 25 which notifies the guard interval length kappa and Identifiers rho and psi, The notice receive section 26 which receives a notice and outputs the guard interval length kappa and Identifier psi which were notified, The guard interval length storage section 29 which outputs the guard interval length kappa who corresponds if the guard interval length kappa and Identifier psi which were inputted are made a set, and are memorized and the identifier psi of a communication place is inputted, While setting guard interval length as kappa, transmit data X is inputted and it has the data symbol transmitting section 30 which transmits the data symbol omega of OFDM.

[0064] Moreover, above-mentioned each part is prepared in a data symbol transmitting side and a

data symbol receiving side, respectively. The measurement symbol transmitting section 22, the notice receive section 26, the guard interval length storage section 29, and the data symbol transmitting section 30 are formed in a data symbol transmitting side. The measurement symbol receive section 23, the notice transmitting section 25, the guard interval length storage section 28, and the data symbol receive section 31 are formed in a data symbol receiving side.

[0065] Thus, as for the OFDM communication device concerning the 2nd operation gestalt of this invention, it is the feature that the measurement symbol transmitting section 22 is formed in a data symbol transmitting side, and the guard interval length storage sections 28 and 29 are further formed in it.

[0066] In addition, since the data symbol transmitting side and the data symbol receiving side are premised on more than one existing, respectively for the OFDM communication device concerning the 2nd operation form of this invention, the guard interval length storage sections 28 and 29 are formed, respectively. However, you may constitute so that the guard interval length storage sections 28 or 29 may be formed only in the equipment side with which in either the data symbol transmitting side or the data symbol receiving side only one exists when only one exists.

[0067] In drawing 5 , the measurement symbol transmitting section 22 transmits two or more measurement symbols which contain the guard interval which has predetermined length like above-mentioned drawing 2 . The measurement symbol concerned consists of a guard interval which has the time length of kappa, and an effective symbol which has predetermined access-control data like above-mentioned drawing 3 .

[0068] An identifier is also contained in this access-control data. A peculiar sign or a peculiar value is beforehand assigned to the identifier so that the transmitting side and receiving side of access-control data can be discriminated from others. Below, the identifier of a measurement symbol transmitting side is set to rho, and the identifier of a measurement symbol receiving side is explained as psi.

[0069] The measurement symbol transmitting section 22 transmits a series of measurement symbols one by one like the OFDM communication device concerning the 1st operation gestalt. Here, it memorizes with a corresponding identifier so that the optimal guard interval length for each communication place may mention later, though two or more communication places exist. Therefore, if transmitted to the timing which opened predetermined time, it is sufficient for a measurement symbol. Of course, a measurement symbol may be transmitted, whenever transmit data occurs, although communication efficiency falls.

[0070] Operation when not being the office where operation in case it is the office where a communication place communicates for the first time first and the optimal guard interval for a communication place is not memorized below is explained, next a communication place communicates for the first time is explained.

[0071] The measurement symbol receive section 23 receives the measurement symbol transmitted through a communication channel 21 one by one, and recognizes the identifiers rho and psi in an effective symbol. The measurement symbol receive section 23 discriminates that the symbol concerned is sent towards a local station by recognizing the identifier psi of a local station. Then, the measurement symbol receive section 23 detects the shortest guard interval length kappa that has recognized Identifiers rho and psi.

[0072] Next, the measurement symbol receive section 23 outputs the guard interval length kappa and Identifier rho to the notice transmitting section 25 and the guard interval length storage section 28. First, the guard interval length storage section 28 makes a set the identifier rho of the guard interval length kappa and measurement symbol transmitting side which were inputted, and memorizes it.

[0073] For example, as mentioned above, if the identifier of the data symbol transmitting side in which the measurement symbol transmitting section 22 is formed is rho, Identifier rho will be made the corresponding guard interval length kappa and a corresponding set, and will be memorized. Moreover, if the identifier of another data symbol transmitting side is nu, Identifier nu is made the optimal guard interval length tau and optimal set for communication with another corresponding communication place, and is memorized. Thus, in the guard interval length storage section 28, the optimal guard interval length for the identifier of a communication place and a communication place is made a set, and is memorized one after another.

[0074] The notice transmitting section 25 notifies the guard interval length kappa and Identifiers rho and psi which were inputted from the measurement symbol receive section 23 to the notice receive section 26 in which it was prepared by the data symbol transmitting side.

[0075] The notice receive section 26 recognizes the identifier rho of the local station contained in the notice transmitted through a communication channel 21, and receives a notice. After receiving, the notice receive section 26 outputs the guard interval length kappa and Identifier psi which are contained in the notice concerned to the guard interval length storage section 29.

[0076] First, the guard interval length storage section 29 makes a set the guard interval length kappa and Identifier psi which were inputted, and memorizes them. The operation is the same as that of the above-mentioned guard interval length storage section 29. Next, the guard interval length storage section 29 outputs the guard interval length kappa corresponding to the identifier psi of a communication place to the data symbol transmitting section 30.

[0077] The data symbol transmitting section 30 sets up the inputted guard interval length kappa as guard interval length of a data symbol transmitting side. Next, the data symbol transmitting section 30 generates the data symbol omega of transmit data X to inputted OFDM using the guard interval length kappa, and transmits to the data symbol receive section 31.

[0078] Moreover, the guard interval length storage section 28 outputs the guard interval length kappa corresponding to Identifier psi to the data symbol receive section 31.

[0079] The data symbol receive section 31 sets up the inputted guard interval length kappa as guard interval length of a data symbol receiving side. Next, the data symbol receive section 31 receives the data symbol omega of OFDM transmitted through a communication channel 21 using the guard interval length kappa, and outputs received-data Y.

[0080] A communication place is the office which communicates for the first time, and the above explanation is related with operation in case the optimal guard interval for a communication place is not memorized. Next, operation when not being the office where a communication place communicates for the first time is explained.

[0081] If transmit data X occurs, refer for the judgment section (not shown) to whether the guard interval length storage section 29 has memorized the identifier of a communication place. Since a communication place is the office which communicates for the first time when the corresponding identifier is not memorized, above-mentioned operation is performed.

[0082] When the corresponding identifier is memorized, the judgment section judges further whether it is the timing which sends a measurement symbol periodically with reference to elapsed time. When it is judged that it is the timing which sends a measurement symbol periodically, operation in the case of being the office where a communication place communicates for the first time, and same operation are performed. Change of the propagation conditions in a transmission line etc. is taken into consideration, and the time interval which sends a measurement symbol periodically is defined beforehand.

[0083] When it is judged that it is not the timing which sends a measurement symbol periodically, the judgment section performs an access demand to the communication place which has for example, the identifier psi. This access demand shall be performed by the communication channel which is not illustrated with an another communication channel 21.

[0084] If an access demand is performed, the identifier of each communication place will be inputted to the guard interval length storage sections 28 and 29. For example, to the guard interval length storage section 28, Identifier rho is inputted and Identifier psi is inputted to the guard interval length storage section 29.

[0085] The identifier psi of a communication place is inputted, and the guard interval length storage section 29 is memorized by psi and the set, and outputs the guard interval length kappa corresponding to psi to the data symbol transmitting section 30.

[0086] The data symbol transmitting section 30 sets up the inputted guard interval length kappa as guard interval length of a data symbol transmitting side. Next, the data symbol transmitting section 30 generates the data symbol omega of transmit data X to inputted OFDM using the guard interval length kappa, and transmits to the data symbol receive section 31.

[0087] Moreover, the identifier rho of a communication place is inputted from the measurement symbol receive section 23, and the guard interval length storage section 28 outputs the guard interval

length kappa corresponding to rho to the data symbol receive section 31.

[0088] The data symbol receive section 31 sets up the inputted guard interval length kappa as guard interval length of a data symbol receiving side. Next, the data symbol receive section 31 receives the data symbol omega of OFDM transmitted through a communication channel 21 using the guard interval length kappa, and outputs received-data Y.

[0089] As explained above, the OFDM communication device of the 2nd example concerning this invention can raise communication efficiency by using a measurement symbol, in order to use the optimal guard interval based on the time delay in adaptation. Moreover, by setting up a different guard interval for every communication place, a guard interval is optimized for every communication place, and communication efficiency can be raised.

[0090] (3rd operation form) Drawing 6 is the block diagram having shown the composition of the OFDM communication device concerning the 3rd operation form of this invention. The measurement symbol transmitting section 22 to which the OFDM communication device concerned transmits a predetermined measurement symbol in drawing 6 , Receive the measurement symbol concerned, and while setting guard interval length as kappa with the measurement symbol receive section 23 which outputs the shortest guard interval length kappa that has recognized The data symbol transmitting section 30 which transmit data X is inputted and transmits the data symbol omega of OFDM, The notice transmitting section 25 which notifies the guard interval length kappa, and the notice receive section 26 which receives a notice and outputs the notified guard interval length kappa, While the output from the notice receive section 26 is inputted and setting guard interval length as kappa, the data symbol omega of OFDM is received and it has the data symbol receive section 31 which outputs received-data Y.

[0091] Moreover, above-mentioned each part is prepared in a data symbol transmitting side and a data symbol receiving side, respectively. The measurement symbol transmitting section 22, the notice receive section 26, and the data symbol receive section 31 are formed in a data symbol receiving side. The measurement symbol receive section 23, the notice transmitting section 25, and the data symbol transmitting section 30 are formed in a data symbol transmitting side. Thus, as for the OFDM communication device concerning the 3rd operation form of this invention, it is the feature that the measurement symbol transmitting section 22 is formed in a data symbol receiving side.

[0092] In drawing 6 , the measurement symbol transmitting section 22 transmits a series of measurement symbols one by one like the OFDM communication device concerning the 1st operation form. The measurement symbol receive section 23 receives the measurement symbol transmitted through a communication channel 21 one by one, and recognizes the access-control data in an effective symbol first. And the measurement symbol receive section 23 detects the shortest guard interval length kappa that has recognized access-control data, and outputs kappa to the notice transmitting section 25 and the data symbol transmitting section 30.

[0093] Next, the notice transmitting section 25 notifies the guard interval length kappa inputted from the measurement symbol receive section 23 to the notice receive section 26 in which it was prepared by the data symbol receiving side. The notice receive section 26 outputs the guard interval length kappa notified through the communication channel 21 to the data symbol receive section 31.

[0094] The data symbol transmitting section 30 sets up kappa inputted from the measurement symbol receive section 23 as guard interval length of a data symbol transmitting side. Then, the data symbol transmitting section 30 generates the data symbol omega of transmit data X to inputted OFDM using the set-up guard interval length kappa, and transmits to the data symbol receive section 31.

[0095] The data symbol receive section 31 sets up kappa inputted from the notice receive section 26 as guard interval length of a data symbol receiving side. Then, the data symbol receive section 31 receives the data symbol omega of OFDM transmitted through a communication channel 21 using the set-up guard interval length kappa, and outputs received-data Y.

[0096] As explained above, the OFDM communication device of the 3rd example concerning this invention can raise communication efficiency by using a measurement symbol, in order to use the optimal guard interval based on the time delay in adaptation. Moreover, a data symbol receiving side can measure leading.

[0097] (4th operation form) <u>Drawing 7</u> is the block diagram having shown the composition of the OFDM communication device concerning the 4th operation form of this invention. The measurement symbol transmitting section 22 which transmits the predetermined measurement symbol in which the OFDM communication device concerned contained Identifiers rho and psi in <u>drawing 7</u> , The measurement symbol receive section 23 which receives the measurement symbol concerned and outputs the shortest guard interval length kappa that has recognized, and Identifiers rho and psi, The guard interval length storage section 28 which outputs the guard interval length kappa who corresponds if the guard interval length kappa and Identifier rho which were inputted are made a set, and are memorized and the identifier rho of a communication place is inputted, The data symbol transmitting section 30 which transmit data X is inputted and transmits the data symbol omega of OFDM while setting guard interval length as kappa, The notice transmitting section 25 which notifies the guard interval length kappa and Identifiers rho and psi, The notice receive section 26 which receives a notice and outputs the guard interval length kappa and Identifier psi which were notified, The guard interval length storage section 29 which outputs the guard interval length kappa who corresponds if the guard interval length kappa and Identifier psi which were inputted are made a set, and are memorized and the identifier psi of a communication place is inputted, While setting guard interval length as kappa, the data symbol omega of OFDM is received and it has the data symbol receive section 31 which outputs received-data Y.

[0098] Moreover, above-mentioned each part is prepared in a data symbol transmitting side and a data symbol receiving side, respectively. The measurement symbol transmitting section 22, the notice receive section 26, the guard interval length storage section 29, and the data symbol receive section 31 are formed in a data symbol receiving side. The measurement symbol receive section 23, the notice transmitting section 25, the guard interval length storage section 28, and the data symbol transmitting section 30 are formed in a data symbol transmitting side.

[0099] Thus, as for the OFDM communication device concerning the 4th operation form of this invention, it is the feature that the measurement symbol transmitting section 22 is formed in a data symbol receiving side, and the guard interval length storage sections 28 and 29 are further formed in it.

[0100] In addition, since the data symbol transmitting side and the data symbol receiving side are premised being the same as that of the OFDM communication device concerning the 2nd operation form on more than one existing, respectively for the OFDM communication device concerning this operation form, the guard interval length storage sections 28 and 29 are formed, respectively. However, you may constitute so that the guard interval length storage sections 28 or 29 may be formed only in the equipment side with which in either the data symbol transmitting side or the data symbol receiving side only one exists when only one exists.

[0101] The measurement symbol transmitting section 22 transmits a series of measurement symbols one by one like the OFDM communication device concerning the 1st operation form. The measurement symbol receive section 23 receives the measurement symbol transmitted through a communication channel 21 one by one, and recognizes the identifiers rho and psi in an effective symbol.

[0102] Next, the measurement symbol receive section 23 detects the shortest guard interval length kappa that has recognized Identifiers rho and psi, and outputs the guard interval length kappa and Identifier rho to the notice transmitting section 25 and the guard interval length storage section 28. First, the guard interval length storage section 28 makes a set the guard interval length kappa and Identifier rho which were inputted, and memorizes them.

[0103] The notice transmitting section 25 notifies the guard interval length kappa and Identifiers rho and psi which were inputted from the measurement symbol receive section 23 to the notice receive section 26 in which it was prepared by the data symbol receiving side.

[0104] The notice receive section 26 recognizes the identifier rho of the local station contained in the notice transmitted through a communication channel 21, and outputs the guard interval length kappa and Identifier psi which are contained in the notice concerned to the guard interval length storage section 29.

[0105] First, the guard interval length storage section 29 makes a set the guard interval length kappa and Identifier psi which were inputted, and memorizes them. Next, the guard interval length storage

section 29 is memorized by Identifier psi and the set, and outputs the guard interval length kappa corresponding to psi to the data symbol receive section 31. Moreover, the guard interval length storage section 28 outputs the guard interval length kappa corresponding to Identifier rho to the data symbol transmitting section 30.

[0106] The data symbol transmitting section 30 sets up the inputted guard interval length kappa as guard interval length of a data symbol transmitting side. Next, the data symbol transmitting section 30 generates the data symbol omega of transmit data X to inputted OFDM using the guard interval length kappa, and transmits to the data symbol receive section 31.

[0107] The data symbol receive section 31 sets up the inputted guard interval length kappa as guard interval length of a data symbol receiving side. Next, the data symbol receive section 31 receives the data symbol omega of OFDM transmitted through a communication channel 21 using the guard interval length kappa, and outputs received-data Y.

[0108] A communication place is the office which communicates for the first time like the OFDM communication device concerning the 2nd operation form, and the above explanation is operation in case the optimal guard interval for a communication place is not memorized. Also about operation when not being the office where a communication place communicates for the first time, it is the same as that of operation of the OFDM communication device concerning the 2nd operation form almost.

[0109] That is, the access demand with a data symbol transmitting side and a data symbol receiving side shall be performed by the communication channel which is not illustrated with an another communication channel 21. If transmit data X occurs, this access demand will be performed and the identifier of each communication place will be inputted to the guard interval length storage section 28 and the guard interval length storage section 29.

[0110] Identifier rho is inputted, and the guard interval length storage section 28 is memorized by rho and the set, and outputs the guard interval length kappa corresponding to rho to the data symbol transmitting section 30.

[0111] The data symbol transmitting section 30 sets up the inputted guard interval length kappa as guard interval length of a data symbol transmitting side. Next, the data symbol transmitting section 30 generates the data symbol omega of transmit data X to inputted OFDM using the guard interval length kappa, and transmits to the data symbol receive section 31.

[0112] Moreover, like the guard interval length storage section 28, Identifier psi is inputted and the guard interval length storage section 29 outputs the guard interval length kappa corresponding to Identifier psi to the data symbol receive section 31.

[0113] The data symbol receive section 31 sets up the inputted guard interval length kappa as guard interval length of a data symbol receiving side. Next, the data symbol receive section 31 receives the data symbol omega of OFDM transmitted through a communication channel 21 using the guard interval length kappa, and outputs received-data Y.

[0114] As explained above, since the OFDM communication device concerning the 4th operation form of this invention uses the optimal guard interval based on the time delay in adaptation by using a measurement symbol, it can raise communication efficiency.

[0115] Moreover, by setting up a different guard interval for every communication place, a guard interval is optimized for every communication place, and the OFDM communication device in this operation form can raise communication efficiency. Furthermore, as for the OFDM communication device in this operation form, a data symbol receiving side can measure leading.

[0116] (5th operation form) Drawing 8 is the block diagram having shown the composition of the OFDM communication device concerning the 5th operation form of this invention. The measurement symbol transmitting section 32 to which the OFDM communication device concerned transmits a predetermined measurement symbol in drawing 8 , While setting guard interval length as kappa with the measurement symbol receive section 33 which receives the measurement symbol concerned and outputs the guard interval length kappa The data symbol receive section 31 which receives the data symbol omega of OFDM and outputs received-data Y, While setting guard interval length as kappa with the notice transmitting section 25 which notifies the guard interval length kappa, and the notice receive section 26 which receives a notice and outputs the notified guard interval length kappa Transmit data X is inputted and it has the data symbol transmitting section 30

which transmits the data symbol omega of OFDM.

[0117] Thus, the point that change the OFDM communication device concerning this operation form to the measurement symbol transmitting section 22 unlike the OFDM communication device concerning the 1st operation form, and the measurement symbol transmitting section 32 is formed, and change to the measurement symbol receive section 23, and the measurement symbol receive section 33 is formed is the feature. Therefore, below, it supposes that it explains in detail only about a different point, and explanation is omitted about the same point as the OFDM communication device concerning the 1st operation form.

[0118] Drawing 9 is the block diagram having shown the detailed composition of the measurement symbol transmitting section 32. The measurement symbol transmitting section 32 is equipped with the common section acquisition section 1 which takes out the second half sections 1/2 of an effective symbol, the null data adjunct 2 which the output from the common section acquisition section 1 is inputted, and adds the data of an amplitude 0 to the end of a guard interval, and the measurement symbol generation section 3 which adds an effective symbol after a guard interval in drawing 9 .

[0119] First, the effective symbol data A are inputted, and the common section acquisition section 1 takes out one half in the second half of the effective symbol data A of portions as the common section, and outputs them to the null data adjunct 2.

[0120] The null data adjunct 2 adds the null data of an amplitude 0 to the end of a guard interval after the inputted common section. The added data are outputted as a guard interval.

[0121] A guard interval is inputted, and the measurement symbol generation section 3 adds an effective symbol after a guard interval, and generates the measurement symbol B. Drawing 10 is a ** type view showing the measurement symbol B generated by making it such. Drawing 10 (a) expresses the measurement symbol B in case guard interval length exceeds one half of the length of the effective symbol data A.

[0122] The above is operation in the case of being set up beforehand, as guard interval length exceeds one half of the length of the effective symbol data A. Usually, it is set up in this way.

[0123] When guard interval length is set below to one half of the length of the effective symbol data A, it becomes different operation from the above. First, the effective symbol data A are inputted, and the common section acquisition section 1 takes out the portion which is equivalent to guard interval length among the second half sections of the effective symbol data A as the common section, and outputs it to the null data adjunct 2. The null data adjunct 2 outputs the inputted common section as a guard interval as it is.

[0124] A guard interval is inputted, and the measurement symbol generation section 3 adds an effective symbol after a guard interval, and generates the measurement symbol B. The guard interval length generated by carrying out drawing 10 (b) in this way expresses the measurement symbol B in the case of being one half of below the length of the effective symbol data A.

[0125] The generated measurement symbol B is changed into an OFDM signal by the reverse discrete-Fourier-transform (IDFT) section, the modulation section, etc. (not shown), and is transmitted to the measurement symbol receive section 33.

[0126] Drawing 11 is the block diagram having shown the detailed composition of the measurement symbol receive section 33. In drawing 11 the measurement symbol receive section 33 The symbol synchronizer 4 which detects the synchronous timing of a measurement symbol from an input signal, The buffer 5 which samples an input signal serially and only effective-data length buffers as data alpha, The buffer 6 which buffers the data alpha inputted by synchronous timing from the buffer 5 as data beta, It has the correlation operation part 7 which calculates the correlation value between Data alpha and Data beta, and the time delay detecting element 8 which finds a time delay from the correlation value inputted from the correlation operation part 7, and a predetermined threshold, and outputs guard interval length.

[0127] first, the received measurement symbol should pass the recovery section, the discrete-Fourier-transform (DFT) section, etc. (not shown) -- it is generated as symbol data C and inputted into the symbol synchronizer 4 and a buffer 5

[0128] The symbol synchronizer 4 asks for the head of a symbol from the inputted signal, and outputs symbol synchronous timing to a buffer 6. A buffer 5 samples the inputted signal one after another, and only effective-data length buffers it. The buffered data are outputted to a buffer 6 and

the correlation operation part 7 one after another as data alpha. A buffer 6 is the symbol synchronous timing inputted from the symbol synchronizer 4, buffers Data alpha and outputs them to the correlation operation part 7 as data beta. Drawing having shown the above operation typically is drawing 12 .

[0129] Drawing 12 is a ** type view showing how Data alpha and Data beta are outputted. As shown in drawing 12 , Data beta are taken out to the detected symbol synchronous timing, and Data alpha are taken out one by one until they reach time [to be equivalent to a guard interval] length. That is, since Data alpha are taken out one by one to a certain timing, the portion taken out from symbol data will slip the second half one after another.

[0130] The data alpha taken out as mentioned above and Data beta are inputted, and the correlation operation part 7 calculates the correlation value between Data alpha and Data beta, and outputs it to the time delay detecting element 8.

[0131] The time delay detecting element 8 computes the time-average value of the inputted correlation value. Furthermore, in order to normalize, the time delay detecting element 8 computes the value which carried out the multiplication of the coefficient delta to the computed value, and sets it to threshold gamma. The graph showing the calculation process of this time delay is drawing 13 .

[0132] Drawing 13 is a graph showing the relation between the value which carried out the multiplication of the coefficient delta to the above-mentioned correlation value, and the amount of delay. In drawing 13 , a vertical axis is the value which carried out the multiplication of the coefficient delta to the correlation value, and a horizontal axis is the amount of delay. The amount of delay is expressed with the taken-out number of times of a sample from Data alpha being serially taken out to a certain timing as mentioned above.

[0133] As shown in drawing 13 , when the amount of delay is 0, the value which carried out the multiplication of the coefficient delta to the correlation value serves as the maximum. This is because the synchronization is taken and it has become the greatest correlation value by the symbol synchronizer 4 as mentioned above.

[0134] Then, Data alpha are serially taken out to a certain timing, and the number of times of a sample increases. If the number of times of a sample increases, the value which carried out the multiplication of the coefficient delta to the correlation value may exceed threshold gamma. The largest amount of delay will be determined as a time delay.

[0135] The time delay detecting element 8 outputs the guard interval length signal D based on the time delay defined as mentioned above. The guard interval length signal D is a signal containing the above-mentioned guard interval length kappa, and is inputted into the notice transmitting section 25 and the data symbol receive section 31. Since the following operation is the same as that of the OFDM communication device concerning the 1st operation form of this invention, it omits explanation.

[0136] As mentioned above, the OFDM communication device in this operation form acquires a correlation peak in the slide position where a delay wave exists, and detects the maximum time delay further using threshold gamma. Therefore, the OFDM communication device in this operation form can compute a time delay to accuracy further rather than the method of detecting the maximum time delay, by using two or more measurement symbols in the OFDM communication device concerning the 1st operation form of this invention.

[0137] Moreover, in the OFDM communication device in this operation gestalt, the long guard interval which added null data to the second half data of an effective symbol, and was generated does not generate an unnecessary correlation peak. Therefore, the maximum time delay can be found correctly.

[0138] (6th operation gestalt) Drawing 14 is the block diagram having shown the composition of the OFDM communication device concerning the 6th operation gestalt of this invention. The measurement symbol transmitting section 32 which transmits the predetermined measurement symbol in which the OFDM communication device concerned contained Identifiers rho and psi in drawing 14 , The measurement symbol receive section 33 which receives the measurement symbol concerned and outputs the guard interval length kappa and Identifier rho, The guard interval length storage section 28 which outputs the guard interval length kappa who corresponds if the guard interval length kappa and Identifier rho which were inputted are made a set, and are memorized and

the identifier rho of a communication place is inputted, The data symbol receive section 31 which receives the data symbol omega of OFDM and outputs received-data Y while setting guard interval length as kappa, The notice transmitting section 25 which notifies the guard interval length kappa and Identifiers rho and psi, The notice receive section 26 which receives a notice and outputs the guard interval length kappa and Identifier psi which were notified, The guard interval length storage section 29 which outputs the guard interval length kappa who corresponds if the guard interval length kappa and Identifier psi which were inputted are made a set, and are memorized and the identifier psi of a communication place is inputted, While setting guard interval length as kappa, transmit data X is inputted and it has the data symbol transmitting section 30 which transmits the data symbol omega of OFDM.

[0139] Thus, the point that change the OFDM communication device concerning this operation gestalt to the measurement symbol transmitting section 22 unlike the OFDM communication device concerning the 2nd operation gestalt, and the measurement symbol transmitting section 32 is formed, and change to the measurement symbol receive section 23, and the measurement symbol receive section 33 is formed is the feature. Therefore, explanation is omitted about the same point as the OFDM communication device concerning the 2nd operation gestalt.

[0140] Moreover, about the composition and operation of the measurement symbol transmitting section 32 and the measurement symbol receive section 33, since it is explained in the description about the 5th above-mentioned operation form, explanation is omitted here.

[0141] As mentioned above, as for the OFDM communication device concerning the 6th operation gestalt of this invention, it is the feature that the measurement symbol transmitting section 32 is formed in a data symbol transmitting side, and the guard interval length storage sections 28 and 29 are further formed in it.

[0142] Therefore, the OFDM communication device concerning this operation form can compute a time delay to accuracy further like the OFDM communication device concerning the 5th above-mentioned operation form rather than the method of detecting the maximum time delay using two or more measurement symbols in the OFDM communication device concerning the 2nd operation form.

[0143] Moreover, by setting up a different guard interval for every communication place like the OFDM communication device of the 2nd example, a guard interval is optimized for every communication place, and communication efficiency can be raised.

[0144] (7th operation gestalt) Drawing 15 is the block diagram having shown the composition of the OFDM communication device concerning the 7th operation gestalt of this invention. The measurement symbol transmitting section 32 to which the OFDM communication device concerned transmits a predetermined measurement symbol in drawing 15 , While setting guard interval length as kappa with the measurement symbol receive section 33 which receives the measurement symbol concerned and outputs the guard interval length kappa The data symbol transmitting section 30 which transmit data X is inputted and transmits the data symbol omega of OFDM, The notice transmitting section 25 which notifies the guard interval length kappa, and the notice receive section 26 which receives a notice and outputs the notified guard interval length kappa, While the output from the notice receive section 26 is inputted and setting guard interval length as kappa, the data symbol omega of OFDM is received and it has the data symbol receive section 31 which outputs received-data Y.

[0145] Thus, the point that change the OFDM communication device concerning this operation gestalt to the measurement symbol transmitting section 22 unlike the OFDM communication device concerning the 3rd operation gestalt, and the measurement symbol transmitting section 32 is formed, and change to the measurement symbol receive section 23, and the measurement symbol receive section 33 is formed is the feature. Therefore, explanation is omitted about the same point as the OFDM communication device concerning the 3rd operation gestalt.

[0146] Moreover, about the composition and operation of the measurement symbol transmitting section 32 and the measurement symbol receive section 33, since it is explained in the description about the 5th above-mentioned operation form, explanation is omitted here.

[0147] As mentioned above, as for the OFDM communication device concerning the 7th operation form of this invention, it is the feature that the measurement symbol transmitting section 32 is

formed in a data symbol receiving side.

[0148] Therefore, the OFDM communication device in this operation form can compute a time delay to accuracy further like the OFDM communication device concerning the 5th above-mentioned operation form rather than the method of detecting the maximum time delay using two or more measurement symbols in the OFDM communication device concerning the 3rd operation form. Moreover, a data symbol receiving side can measure leading like the OFDM communication device of the 3rd example.

[0149] (8th operation form) <u>Drawing 16</u> is the block diagram having shown the composition of the OFDM communication device concerning the 8th operation form of this invention. The measurement symbol transmitting section 32 which transmits the predetermined measurement symbol in which the OFDM communication device concerned contained Identifiers rho and psi in <u>drawing 16</u> , The measurement symbol receive section 33 which receives the measurement symbol concerned and outputs the guard interval length kappa and Identifier rho, The guard interval length storage section 28 which outputs the guard interval length kappa who corresponds if the guard interval length kappa and Identifier rho which were inputted are made a set, and are memorized and the identifier rho of a communication place is inputted, The data symbol transmitting section 30 which transmit data X is inputted and transmits the data symbol omega of OFDM while setting guard interval length as kappa, The notice transmitting section 25 which notifies the guard interval length kappa and Identifiers rho and psi, The notice receive section 26 which receives a notice and outputs the guard interval length kappa and Identifier psi which were notified, The guard interval length storage section 29 which outputs the guard interval length kappa who corresponds if the guard interval length kappa and Identifier psi which were inputted are made a set, and are memorized and the identifier psi of a communication place is inputted, While setting guard interval length as kappa, the data symbol omega of OFDM is received and it has the data symbol receive section 31 which outputs received-data Y.

[0150] Thus, the point that change the OFDM communication device concerning this operation form to the measurement symbol transmitting section 22 unlike the OFDM communication device concerning the 4th operation form, and the measurement symbol transmitting section 32 is formed, and change to the measurement symbol receive section 23, and the measurement symbol receive section 33 is formed is the feature. Therefore, explanation is omitted about the same point as the OFDM communication device concerning the 4th operation form.

[0151] Moreover, about the composition and operation of the measurement symbol transmitting section 32 and the measurement symbol receive section 33, since it is explained in the description about the 5th above-mentioned operation form, the explanation is also omitted.

[0152] As mentioned above, as for the OFDM communication device concerning the 8th operation form of this invention, it is the feature that the measurement symbol transmitting section 32 is formed in a data symbol receiving side.

[0153] Therefore, the OFDM communication device in this operation form can compute a time delay to accuracy further like the OFDM communication device concerning the 5th above-mentioned operation form rather than the method of detecting the maximum time delay using two or more measurement symbols in the OFDM communication device concerning the 4th operation form.

[0154] Moreover, by setting up a different guard interval for every communication place like the OFDM communication device of the 4th example, a guard interval is optimized for every communication place, and the OFDM communication device in this operation form can raise communication efficiency. Furthermore, as for the OFDM communication device in this operation form, a data symbol receiving side can measure leading.

[Translation done.]